THE WAX OF STINGLESS BEES (MELIPONIDÆ) AND THE USES TO WHICH IT HAS BEEN PUT

By Herbert F. Schwarz

We are indebted to bees especially for three things: their indispensable service as pollinators of plants, whereby they make possible life as we know it; their welcome contribution of a table delicacy, honey; their production of a substance, beeswax, that has commercial value. The pollination of plants is the function of bees of all kinds. The production of honey in edible quantities and of beeswax is, on the other hand, apt to be associated primarily with the honeybee, *Apis*. No one would want to underestimate the contribution that this insect has made to general well-being through furnishing in abundance these valued products. Nevertheless, it is perhaps only proper to point out that before the discovery of America the indigenes of this Hemisphere were dependent for both honey and wax on the native stingless bees. There was even an apiculture in Mexico and southward of Mexico into northern South America.

While honey was the principal object of this culture, beeswax, too, found employment. In ancient Mexico beeswax was an essential in the goldsmith's craft, being used in the preparation of the molds for the gold ornaments and figurines that are so characteristic of the art of Mexico and Central America.[1] An earlier and a later technique are indicated and in the later process workmanship in wax received greater emphasis than it did in the earlier one.

While beeswax was used in metallurgy even in pre-Columbian times, there is some doubt whether before the Discovery the native populations of Mexico and Central America were aware of its possibilities as a medium of illumination. Indeed, the testimony of more than one early visitor to the region south of the Rio Grande is to the effect that this common use for beeswax was not originally recognized by the aborigines. Gómara, writing about the middle of the Sixteenth Century, stated that the native people

[1] Saville, M. H., 1920, The Goldsmith's Art in Ancient Mexico (Indian Notes and Monographs, Mus. Amer. Indian, Heye Foundation), pp. 125–142.

of Yucatan cultivated large hives and thus had plenty of honey and wax, but he added that they did not know how to use wax for illumination until they were taught how to make candles by the Spaniards.[2] Santarén, who is known to have been in the territory of the Acaxee, a mountain tribe of Durango and Sinaloa in 1600, wrote with reference to beeswax that the Indians "now know how to make of it candles for the church," with the implication that probably no use was made of wax for lighting purposes by the Indians prior to their contact with the Whites.[3] On the other hand, Redfield and Villa R[4] or at least the senior author expressed the opinion that probably "The Middle Americans burned wax as an offering to the gods, as they burned rubber, copal, and other substances," although conclusive proof could not be offered. Certain we are of one thing, in spite of these conflicting viewpoints, and that is that the use of wax for illumination was greatly stimulated by ecclesiastical demand. The Indians apparently soon learned the significance of wax for the making of candles, and as a result wax became an important item of commerce not only in Mexico but in other regions, often far distant, as well.

One of the chief ways in which the wax of stingless bees was used in South America was for the making of candles.[5] Many of the native tribes apparently made such candles for sale to Europeans. They were used in rural churches and in the Indian missions.[6] According to Maximilian, Prince of Wied-Neuwied,[7] the Tapuya of Brazil prepared such candles by winding about a thin core of wax a wick of cotton and then rolling the whole

[2] Gómara, F. L. de, 1564, Historia delle Nvove Indie Occidentali, Pt. 2, p. 65; 1940, The Conquest of the Weast India, p. 200.

[3] Beals, R. L., 1933, Ibero-Americana, Vol. 6, p. 10.

[4] Redfield, R., and Villa R, A., 1934, Chan Kom, A Maya Village (Carnegie Inst. Washington, No. 448, p. 366).

[5] Saint-Hilaire, A. de, 1830, Voyages dans les Provinces de Rio de Janeiro et de Minas Geraes, Vol. 2, p. 371; 1848, Voyage aux Sources du Rio de S. Francisco et dans la Province de Goyaz, Vol. 2, p. 164. Also Lepeletier, A., 1836, Histoire Naturelle des Insectes—Hyménoptères, Vol. 1, p. 414.

[6] Azara, F. de, 1809, Voyages dans l'Amérique Méridionale, Vol. 1, pp. 161–162.

[7] Maximilian, 1820, Reise nach Brasilien in den Jahren 1815 bis 1817, Vol. 1, p. 142.

firmly into one mass. The same author stated[8] that the Camacans of Brazil arranged the candles intended for sale in long strings, then placed them in elongated bundles and finally pasted a covering of large leaves on the outside. The Patacho of the same country brought great balls of black wax to a settlement for the purpose of making trades.[9] Saint-Hilaire used candles made of of the purified wax of stingless bees and found such candles satisfactory although inclined to drip and give forth much smoke.[10] Others have indicated that they were of inferior quality. Gardner spoke of these wax tapers as coarse and "about a yard long." His observations were made in Goyaz.[11]

To this day apparently beeswax is used in the Mayan village of Chan Kom for making ceremonial candles. According to Redfield and Villa R [12] the method of making these wax candles is identical with that used for those of paraffin. From a wooden ring placed horizontally are hung about fifty wicks and, as this ring is revolved, melted wax is poured over the wicks until the particular diameter desired is attained. Wax candles of this type are either yellow or black, some hives producing wax of darker color than do other hives. Candles of black wax are occasionally lighted at funerals of grown-ups and at that part of the All Souls' Day ceremonies when there is commemoration of the adult dead.

Redfield and Villa R found that beeswax is at Chan Kom used for black magic. Figures are made of it and "there is a belief that children who play with it become somnambulists."

In Java the wax of *Trigona* (*Tetragona*) *iridipennis* F. Smith is used by the natives for the production of "Battik," a substance for coloring calicoes and other textiles.[13]

Peckolt mentioned[14] that in southern Brazil the indigenes used the

[8] *Idem*, Vol. 2, p. 219.

[9] *Idem*, Vol. 1, p. 284.

[10] Saint-Hilaire, A. de, 1848, Voyage aux Sources du Rio de S. Francisco et dans la Province de Goyaz, Vol. 2, pp. 164–165.

[11] Gardner, George, 1846, Travels in the Interior of Brazil, First Edition, p. 329; 1849, *idem*, Second Edition, p. 250.

[12] Redfield, R., and Villa R, A., 1934, Chan Kom, A Maya Village (Carnegie Inst. Washington, No. 448, p. 49).

[13] Schulz, W. A., 1907, Zeitschr. Wiss. Insektenbiol., Vol. 3, p. 67.

[14] Peckolt, T., 1893, Natur, Vol. 42, p. 580.

wax for attaching their feather finery and other things. Later[15] that author stressed as particularly sought for this purpose, the very sticky wax of "*Melipona longiceps* Smith," which was doubtless a slip of the pen for *Trigona longipes* Smith, but may be based on a misconception of the true character of *longipes,* a synonym of *varia* Lepeletier.

According to Rayment[16] in northern Australia the aborigines decorated their head by attaching beeswax balls or beads to the ends of wisps of their hair. Similarly they used beeswax to form knobs on tassels of various ornaments, heightening the effect by pressing into the wax the scarlet seeds of the leguminous plant, *Abrussus.*

A further use which certain Australian natives have found for beeswax is as a coping to protect their rock-paintings from rain that might otherwise run down the sloping surface of the rock and damage the picture. This is the practice of the Worróra, and in a picture cave of this tribe Love[17] found a semicircle of beeswax over two representations of Waráhninya, the wedge-tailed eagle.

An Indian tribe (the Pury) living in Minas Geraes, Brazil, used the wax of stingless bees in the fabrication of their arrows and bows and also in making candles for sale to the Portuguese.[18] By the Xicaque Indians of Honduras, I am informed by Mr. V. W. von Hagen, the wax of stingless bees was used for blowgun sights and for fixing arrows.

In Cuba wax of the stingless bee, *Melipona beecheii* variety *fulvipes* Guérin, was used in lithography. References to this use of the wax appear both in Felipe Poey's account[19] and also in that of his son, Andre Poey.[20] A lithographer of Havana by the name of Marquier was the originator of the plan for using the dark wax of this bee in the manufacture of lithographic ink, and the ink made of this native wax proved more suitable for the pur-

[15] Peckolt, T., 1893, *idem,* Vol. 43, p. 91.

[16] Rayment, T., 1935, A Cluster of Bees, pp. 512–513.

[17] Love, J. A. B., 1929–1930, Jour. Royal Soc. Western Australia, Vol. 16, p. 9.

[18] Maximilian, Prince of Wied-Neuwied, 1820, Reise nach Brasilien in den Jahren 1815 bis 1817, Vol. 1, p. 142.

[19] Poey, F., 1851, Memorias sobre la Historia Natural de la Isla de Cuba, Vol. 1, p. 169.

[20] Poey, A., 1855, Bull. Soc. d'Acclim., Vol. 2, pp. 334–336.

pose than did the imported ink of Europe. Subsequently lithographic pencils were also manufactured from this wax. But these instances do not cover all the known uses for the native wax in Cuba. In addition, Felipe Poey noted that it was employed in fastening artificial flowers, in mending shoes, in removing corns, in fastening boys' kites, etc.

Just how corns were removed or "cured" is not made clear but this was not the only medicinal use for the wax of stingless bees. The wax of *Trigona* (*Schwarziana*) *quadripunctata* variety *bipartita* (Lepeletier) was, according to Peckolt,[21] prized more highly than any other native wax of southern Brazil for salves and plasters, and Spix and Martius[22] likewise indicated that the wax of stingless bees was put to these uses. The fragrant wax of "Yatëi" (*Trigona jaty* F. Smith) was used, according to Wappaeus[23] in Paraguay "only for perfume or in rural medicine."

Writing from Moulmein, Parish[24] spoke of the preparation and use in Burma of propolis (known as *Pwai-ngyet*). Boiled in water and softened thereby, it is then given an admixture of petroleum and kneaded until it has the consistency of putty. In this form its principal use is for caulking boats.[25] Parish indicated that Pwai-ngyet in the limited sense is the product gathered by *Trigona* (*Tetragona*) *laeviceps*, which is a synonym of *Trigona* (*Tetragona*) *iridipennis* F. Smith. A South American species, too, furnishes a resinous material prized for the caulking of leaking canoes. This species is *Trigona fulviventris* variety *guianæ* Cockerell, which, according to Miss L. E. Cheesman, stores large yellow lumps used by Colombian fishermen for this purpose.[26]

In East Africa, on the other hand, Morstatt found that wax of all species of stingless bees was used to make canes and ropes pliant.[27]

[21] Peckolt, T., 1894, Natur, Vol. 43, p. 90.

[22] Spix, J. B. von, and Martius, C. F. P. von, 1928, Reise in Brasilien in den Jahren 1817 bis 1820, p. 523.

[23] Wappaeus, J. E., 1867, Die Republik Paraguay, p. 1157.

[24] Parish, C. S. P., 1866, Science Gossip, pp. 198–199.

[25] Cook, M. C., 1865, Science Gossip, p. 252.

[26] Cheesman, L. E., 1929, Trans. Ent. Soc. London, Vol. 77, p. 149.

[27] Morstatt, H. A., 1921, Arbeiten Biol. Reichsanstalt für Land- und Forstwirt., Vol. 10, p. 299.

It has long been known that ambergris is a product of the sperm whale—an origin sufficiently remarkable but far eclipsed by that assigned to it in a seventeenth century article on stingless bees,[28] in which it is stated:

"He (Monsieur Villermont) promises to show me, that Ambergrise is nothing but wax, mixt with the Honey, which falls into the Sea, and is beat about in the Waves, between the Tropics."

One could almost wish that this fantastic explanation had validity, so that yet another use for the wax of stingless bees might be added to those already cited.

The wax when it issues from the wax-producing glands is approximately as pale as that produced by *Apis*, but almost always it is subsequently mixed by the bees with alien materials that give it a darker color. It is true that Bertoni[29] classifies Paraguayan bees' wax as follows: (1) of brown color and much mixed with woody materials (*amalthea* and *tataira*); (2) of ferruginous color (various *Melipona* and *Trigona* (*Cephalotrigona*) *capitata* F. Smith); (3) of clear yellow color and soft (various *Trigona*). In general, however, the wax used in the nest architecture is far from pure and tends to be dark in color. It was the conclusion of Fritz Müller[30] that in some species no more than 10% of the building material is wax, resinous substances and clay accounting for the other 90%. It is no surprise that, even in cases where the admixture of foreign materials is much less, this impure dark wax is often very resistant to blanching. When Azara was making his journey through the South American wilderness in the late Eighteenth Century no way was known of bleaching it.[31] Nor was any blanching method known in northern South America, for Fermin in his account of Surinam shortly after the middle of the Eighteenth Century indicated that the dark wax of the stingless bees of the region remained permanently dark.[32]

The Count da Barca, minister of the king, made repeated at-

[28] I, Mr., 1685, Philosophical Transactions, Vol. 15, p. 1031.

[29] Bertoni, A. de W., 1912, An. Mus. Nac. Hist. Nat. Buenos Aires, Vol. 22 (Ser. 3, Vol. 15), p. 139.

[30] Müller, Fritz, 1874, Nature, Vol. 10, pp. 102–103.

[31] Azara, F. de, 1809, Voyages dans l'Amérique Méridionale, Vol. 1, p. 161.

[32] Fermin, 1769, Description de la Colonie de Surinam, Vol. 2, p. 301.

tempts, according to Saint-Hilaire,[33] to give the indigenous wax of Brazil a light color, yet had not succeeded. On the other hand, Saint-Hilaire observed at Goyaz a workman who had discovered a successful method, which consisted of melting it, dividing it into small bits and exposing these to the sun. He repeated this process sixteen times, consuming two to three months in doing so, but in the end the wax was almost as white as that of the domestic honeybee. Not all wax had to be bleached, however, for according to Azara,[34] a large stingless bee found at Santiago del Estero in the Chaco produced a pale wax that could be mingled up to a half with tallow. Inhabitants of the region gathered annually about 14,000 pounds of this wax. Bertoni[35] spoke of the wax of *Trigona* (*Plebeia*) *mosquito* Smith, as "almost white," and Burlamaqui referred to the wax of one Brazilian stingless bee that was paler than that of the Old World honeybee and superior in quality. The bee in question, it was said, nested in hollows of trees in certain regions near the Amazon.[36]

Peckolt made analyses of the ingredients in the wax of stingless bees as he did of the ingredients in the honey. The wax of the following species was analyzed: *droryana* and *ruficrus* among *Trigona,* and *fuscata* among *Melipona.* Wax, resin, water, ash, were present in varying proportions in each case and usually there was also present a humus-like substance. The wax in each case exceeded 50 per cent of the total, ranging from 52 per cent to 59 per cent. Resin was present in the proportion of about 31 per cent to 42.5 per cent. The analyses are based on too limited a study of material to be applied more generally. Some species are known to use other foreign substances than those included by Peckolt, but it is interesting at least to find the wax content so high in the conglomerate material studied. However, the percentages cited did not apply to the brood-envelope, where the wax ranged from about 11 per cent to about 20 per cent, and where, in

[33] Saint-Hilaire, A. de, 1848, Voyage aux Sources du Rio de San Francisco et dans la Province de Goyaz, Vol. 2, p. 164.

[34] Azara, F. de, 1809, Voyages dans l'Amérique Méridionale, Vol. 1, pp. 161–162.

[35] Bertoni, A. de W., 1912, An. Mus. Nac. Hist. Nat. Buenos Aires, Vol. 22 (Ser. 3, Vol. 15), p. 145.

[36] Raveret-Wattel, M., 1875, Bull. Soc. d' Acclim., Ser. 3, Vol. 2, p. 757.

addition to resin and humus-like substances, not to mention plant material, there were in substantial proportions organic substances soluble in water and organic salts.[37] In the analyses of the brood envelope Peckolt apparently failed to include an analysis of the brood envelope of *ruficrus*.

The process of preparing the wax in Cuba was described by Poey.[38] The wax was obtained from the provision containers, which were first thoroughly cleansed of honey and of pollen and, when dry, placed in a pan over a slow fire. The melted part was drawn off, and if any dregs remained at the bottom of the pan, they were thrown away. Another method was to boil the wax in water, and to skim it from the surface of the brew, or to strain it through a linen cloth; but this method, which worked well enough in the case of wax of the European honeybee, is, according to Poey, unsuited in the case of the dark wax of the stingless bees. In the Mayan village of Chan Kom the inhabitants clarify wax by melting it and then placing it in cold water, whereupon the good wax comes to the surface. "The wax which is no good stays underneath."[39]

From East Africa used to be shipped from time to time wax that passed under the name of "bumblebee wax," but as there are no bumblebees south of the Mediterranean region of Africa, the designation was obviously a misnomer. The wax in question—of an inferior quality—was the product of stingless bees.[40] Doubtless there are many other uses to which the wax of stingless bees has been put in the Old World and the New, but the instances here offered indicate at least that this wax has proved its worth in a great variety of applications.

[37] von Ihering, H., 1904, Zool. Jahrb. System. Geogr. und Biol., Vol. 19, pp. 267–269.

[38] Poey, F., 1851, Memorias sobre la Historia Natural de la Isla de Cuba, Vol. 1, p. 168.

[39] Redfield, R., and Villa R, A., 1934, Chan Kom, A Maya Village. Carnegie Inst. Washington, No. 448, pp. 49, 50.

[40] Morstatt, H. A., 1921, Arbeiten Biol. Reichsanstalt für Land- und Forstw., Vol. 10, pp. 283–284.